A Study of the Rose Run Sandstone and Its Oil and Gas Potential at the Knox Unconformity in Ohio

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by

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INTRODUCTION

The need to explore for new deposits of oil and gas, in a world where consumers' needs are rapidly depleting known reserves, is obvious. So much of our modern way of life depends on oil and gas and their products. With each year, oil consumption increases dramatically, while discovery of new reserves lags far behind. It is a matter of supreme urgency for the United States, the world's largest consumer of oil and gas, to drastically step up its search for domestic reserves, because increasing dependency on foreign supplies puts us in quite a vulnerable position. It is just a matter of time before the national security is at stake. Energy self-sufficiency for our country should be a goal of prime importance.

Before starting this project, I was under the false impression that most of the sediments in Ohio and the surrounding area were more or less thoroughly explored. One of the main reasons why I felt this way was because there is a feeling in this country that not much more domestic oil and gas remains to be found. Hardly ever are proposals made to increase domestic exploration as a remedy to the present oil crisis, but there is much talk of the problems we will face when foreign suppliers cut us off. What was once cheap foreign oil is now very expensive, and yet we still seem to be totally preoccupied with finding more foreign suppliers. The ever-increasing costs of obtaining foreign supplies could be well spent in this country developing domestic reserves. This would help reduce our foreign dependency, and at the same time keep the revenue in our own country, yet this alternative seems almost totally ignored.

Because of our never ending drive to obtain more foreign oil, I was very surprised to learn that great unexplored thicknesses of lower Paleozoic sediments remain in Ohio. A major portion of these unexplored sediments is within the Knox Group, in which the Rose Run Sand is a part. In the Cincinnati Arch Province alone the Knox Group makes up 45.5 percent of the sediments from the Pennsylvanian System to the Precambrian basement (D. C. Bond et al., 1971). The regional Knox unconformity truncates many porous sediments of the Knox Group, and in many areas significant relief is known to exist at the unconformity, which is regionally overlain by the impermeable Glenwood Shale. Accordingly, the Knox unconformity is a prime exploration target in Ohio. This is illustrated by the fact that among the five major reservoirs found in Ohio since 1900, three were found within the Knox, and all three were in some way related to the Knox unconformity.

One of these three unconformity related discoveries was in the Rose Run Sand. It was first found productive in Holmes County in 1965 when the No. 1 Ruben Erb (Permit 1328) was completed as a gas well. Following this discovery, the Rose Run became the exploration target of several wells in the east-central Ohio area. A. Janssens, a geologist who has devoted much study to the Knox in Ohio, states (1973) "Especially favorable areas for production from the Knox are the two or three tiers of counties south of Lake Erie and the subcrop belt of the Rose Run sandstone below the Knox unconformity ".

Since Janssens made the preceeding statement in 1973, very little exploration of the Rose Run has occurred; therefore, to this day the opportunity for discovery in the Rose Run remains very attractive. Hydrocarbons in commercial amounts have already been found in many of the few wells drilled to this sand (see Appendix C), yet vast unexplored areas along the

Rose Run's subcrop remain (see Map 1). The only area that has been drilled in reasonable detail is the east-central Ohio area near the discovery well mentioned above. This is the only place along the entire Rose Run subcrop that provided sufficient control for detailed mapping.

Most of the available evidence indicates that the Rose Run sandstone is a very promising reservoir rock. Previous discoveries alone testify that favorable conditions for oil and gas entrapment can, and do exist within this sand, but there is further evidence as well. The Rose Run is suspected of being the only persistent sandstone within the Knox (Janssens, 1973) and most tests, whether successful or unsuccessful, reveal favorable porosity in the sand. One well (Permit 219) drilled in Elizabeth Township, Lawrence County, Ohio, far from the major producing area of east-central Ohio, encountered salt water in the sandstone. Log analysis of another well, a Pre-Cambrian test (Permit 174) drilled in nearby Symmes Township, Lawrence County, "revealed favorable porosity in the Rose Run" (Janssens, 1977). Both of these wells serve to illustrate that excellent reservoir characteristics are present, not only in areas of current production, but elsewhere within the Rose Run, also far from where major production is currently taking place. Evidence from the No. 1 Ruben Erb well suggests that the porosity along the Rose Run subcrop may be primary rather than secondary, which was previously assumed (Janssens, 1973).

A general description of the Rose Run by Janssens (1973) also attests to the favorable reservoir potential of this sandstone. He characterizes the Rose Run as follows. "The sandstone is poorly consolidated in well samples, fine to coarse grained, poorly sorted in samples, slightly dolomitic, and in places slightly glauconitic. Degree of rounding of individual grains ranges from subangular to rounded, and is predominantly subrounded. Frosted grains are common among the rounded and subrounded grains. Sandy dolomite is interbedded with the sandstone and predominates in the lower portion of the zone." He also goes on to say that "In general, the upper portion of the Rose Run, in which sandstone predominates over dolomite, is about 50 feet thick, and the lower portion, in which dolomite predominates over sandstone, is about 70 feet thick".

The characteristics described above, favorable porosity, lateral persistence of the sand, and thickness, would not result in occurrence of oil and gas unless suitable trapping conditions existed. In the Rose Run, two major trap types are not only possible, but are quite probable. Since the Rose Run subcrop is regionally overlain by the impermeable Glenwood Shale at the unconformity, any geomorphic or structural high along the subcrop would create a reservoir ideal for oil and gas entrapment. It has already been mentioned that significant relief at the unconformity appears to be commonplace. Even more significant than this, is the potential of stratigraphic trapping along the westernmost edge of the Rose Run subcrop as the sand pinches out westward, updip from the regional structure. This is due to truncation of the unit further west over the Cincinnati Arch by the Knox unconformity. Patton and Dawson (1969) suggest that this "physical situation is analogous to that of the East Texas Field and numerous other petroleum sources large and small".

PURPOSE OF STUDY

The major purpose of this study is to attempt to learn where favorable conditions exist within the Rose Run for oil and gas. Subsurface mapping is vital for accomplishing such a goal. Maps by A. Janssens (see Maps 1, 2 and 3) serve to show the regional characteristics of the Rose Run, while my maps (see Maps 4, 5 and 6) attempt to characterize the more restricted east-central Ohio area in much more detail. As with any mapping project such as this, much of what the maps show is interpretation, for no one can be absolutely sure of the local geology between drilling sites. Only at the well can one actually look at the rocks and say "this is the way things are", but even this can be uncertain. It then follows that where more well control is available, less interpretation is necessary.

This report focuses on a subsurface study conducted by me in east-central Ohio based on well information from approximately 60 deep test wells which penetrated the Rose Run or deeper strata. In this study I used well information cards from the Ohio Geological Survey to obtain data (see Appendix A and B, well information cards are also included) for the preparation of three maps.

A structure map on the Knox unconformity (Map 6) has been prepared, as well as two isopach maps. One isopach is of the Rose Run Sand (Map 5), the other is of the overlying Beekmantown Dolomite (Map 4). The zero edges obtained by both of these isopach maps define the probable subcrop area which has been transferred to the structure map. In addition, well cuttings on file with the Ohio Department of Natural Resources were studied as a check when anomolous situations were encountered in the mapping process (Appendix D). This paper also contains a brief discussion of the Knox in order to put the local study into regional perspective. The maps by Janssens (1973) have been included to illustrate the regional characteristics of the Knox.

STRATIGRAPHY

The Rose Run Sandstone was first named and described by L. B. Freeman (1949, 1953) from a well drilled by Judy and Young on the property of the Rose Run Iron Company, Bath County, Kentucky. The section penetrated by this well represents the type section of the Rose Run Sandstone. In Ohio this sandstone was later defined by Janssens (1973) as "a blanket sandstone within the Knox of eastern Ohio". The Knox Dolomite, and consequently the Rose Run, are Cambrian-Ordovician in age and both are found in the subsurface of eastern Ohio. The top of the Knox is bounded by the regional Knox unconformity which truncates the Rose Run sand as it rises up dip out of the Appalachian Basin. Consequently, the Rose Run subcrops at the unconformity in eastern Ohio.

The Rose Run, as a sandy zone within the Knox of Ohio, falls within a stratigraphic division informally known as the Sauk Sequence. In Ohio this division encompasses all the rocks bounded below by the Precambrian basement, and above by the regional Knox unconformity. Through the years, the stratigraphic nomenclature of the Sauk Sequence in Ohio has gone through constant revision. Originally, Sauk nomenclature of Wisconsin was used. This was first done in a study by Wasson (Janssens, 1973). Until the early 1960's this nomenclature appeared to fit the Sauk rocks of Ohio moderately well, but as more and more wells penetrated the Cambrian-lower Ordovician in Ohio, problems became apparent. In 1962 the Ohio Division of Geological Survey adopted nomenclature introduced by Calvert in the Appalachian area, exemplified by the Rose Hill District of Virginia (Janssens, 1973). Even this nomenclature grew obsolete, for Janssens (1973) states "evidence obtained from the numerous additional wells drilled since 1961 indicates that, in terms of gross sub-Knox Sauk lithology, Ohio can be subdivided into four areas, in only one of which do the Sauk rocks resemble those of the Rose Hill district". Various other modified forms of the nomenclatures discussed above have been proposed by numerous geologists, but with time and the accumulation of additional knowledge of the Sauk rocks of Ohio, these proposals become outdated. Janssens has developed the most widely used, up-to-date, Sauk nomenclature of Ohio known to me, and this is the nomenclatural system used in this report. A correlation chart (Fig. 1) and a stratigraphic column (Fig. 2) by Janssens (1977, 1973) have been included with this report to illustrate the system.

Stratigraphically, the Knox Dolomite underlies the regional Knox unconformity and it may overlie either the Kerble, Eau Claire, or Conasauga Formation, depending on location (see Fig. 2). As the correlation chart shows (Fig. 1), the Cambrian-Ordovician boundary is presumed to lie somewhere within the Knox, but its exact location cannot be determined in Ohio with existing fossil control. Fossil evidence for placement of this systematic boundary has never been obtained from the Knox in Ohio. It is for this reason that the Rose Run is assigned a Cambro-Ordovician age because it is uncertain whether this sand lies above or below the Cambrian-Ordovician boundary. Apparently, this boundary must be located at some lithically obscure and undeterminable horizon within the Knox. To solve this problem Calvert (1962, p. 41-43) proposed moving the boundary up to make it coincide with the Knox unconformity but this was never widely accepted

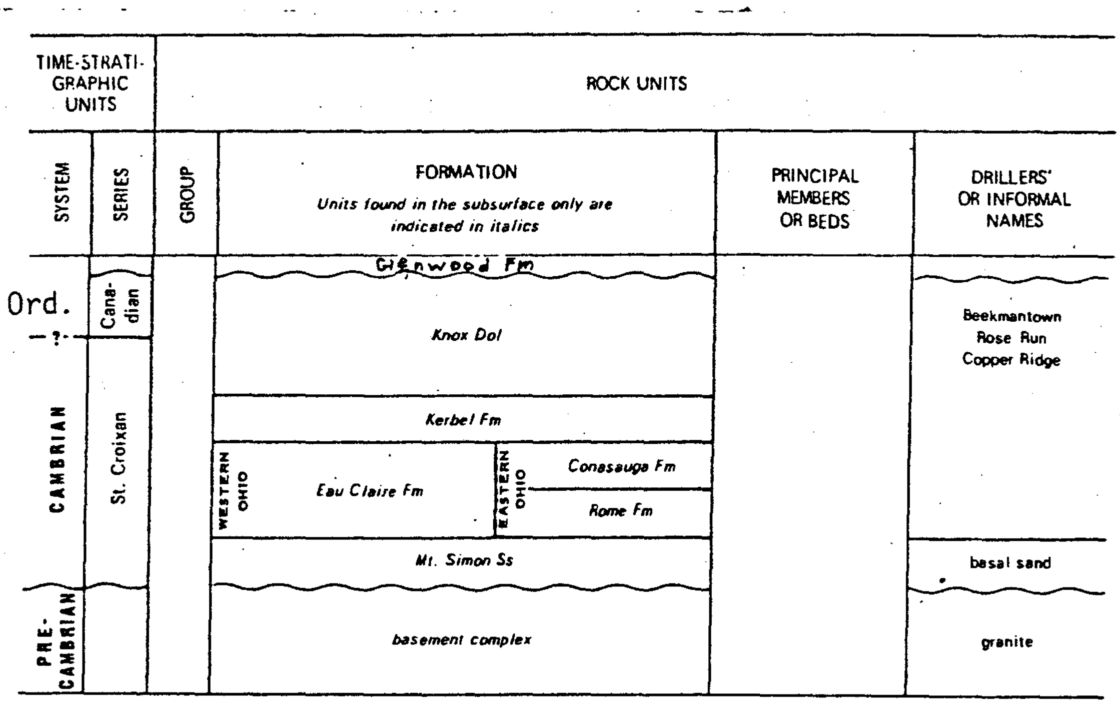

FIGURE 1 –Correlation chart of Cambrian and Lower Ordovician rocks.
(From Janssens, 1977)

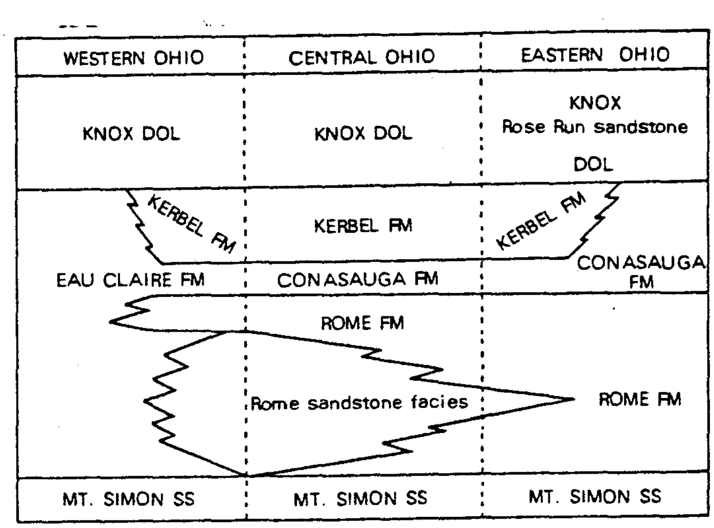

FIGURE 2 –Stratigraphic column of the Sauk sequence in Ohio.
(From Janssens, 1973)

because a systematic boundary such as this one should be based on faunal evidence, not placed at just any lithic horizon for the sake of convenience.

The only place in Ohio where consistent criteria for subdividing the Knox Dolomite have been found is in the eastern part of the state. Drillers and petroleum geologists informally subdivide the Knox Dolomite into the "Copper Ridge" or "Trempealeau" below the Rose Run Sand, and the "Beekmantown" above. "The Ohio Geological Survey does not follow this usage because the differentiation between "Trempealeau" and "Beekmantown" should be based on a distinction of relative age as determined from fossil evidence. As far as is known, this faunal evidence has not been obtained in the Appalachian Basin" (Janssens, 1977).

The obscurity of the Cambrian-Ordovician boundary coupled with the apparent scarcity of fossils in the Knox, make proper correlation of the Rose Run a very difficult problem. Historically, before the Rose Run was known to exist in eastern Ohio, it was often mistakenly identified as the St. Peter Sandstone. Presently, in the Midwest, the St. Peter Sandstone is suspected of being present no further eastward than western Indiana (Patton and Dawson, 1969). In western Pennsylvania, Wagner (1966) found the upper sandy member of the Gatesburg Formation correlative to the Rose Run but, as Wagner points out, an apparent discrepancy exists if these two sandy zones are to be viewed as time-stratigraphic units. This discrepancy results from the unsystematic placement of the Cambrian-Ordovician boundary from state to state. In Pennsylvania this boundary lies on top of the Gatesburg Formation (Mines member), in Kentucky "it is placed below or at the base of the Rose Run" (McGuire and Howell, 1963, from Janssens, 1973), whereas in Ohio the position of this boundary is uncertain.

In southeastern Indiana, there exists a sandstone within the Knox Dolomite informally called the Knox Sandstone by Patton and Dawson (1969). This sandstone subcrops at the Knox unconformity along the western flank of the Cincinnati Arch much like the Rose Run does along the eastern flank of the arch in Ohio. Like the Rose Run, the Knox sandstone has been mistakenly confused with the St. Peter Sandstone in the past. Janssens (1973) states that "In thickness and regional stratigraphy this sandstone resembles the apparently thick Rose Run Sandstone found in three wells in south-central Ohio". Even though the Knox sandstone and the

Rose Run Sandstone greatly resemble each other in character and stratigraphic position, no one has as yet been able to show definitely that the two units are equivalent. Several factors indicate that these units are correlative, but additional well control is urgently needed to resolve this problem.

REGIONAL CHARACTERISTICS OF THE KNOX

The regional character of the Knox is best illustrated by three maps from Janssens (1973). These maps (Maps 1, 2 and 3) can be found in the pocket at the front of this report.

Map 1 is a regional isopach map of post-Rose Run Knox Dolomite, or "Beekmantown" Dolomite. As this map shows, the "Beekmantown" pinches out in an updip westerly direction because of post-Knox truncation at the Knox unconformity. Like the "Beekmantown", the underlying Rose Run also pinches out westward. As a result, the Rose Run subcrops at the unconformity in a relatively narrow strip which trends northeast-southwest. As shown, the Rose Run subcrop area is quite persistent in the subsurface of Ohio.

Map 2 is a regional isopach map of the Knox Group, including the Rose Run. As this map shows, the Knox varies greatly in thickness within the state of Ohio. The thickness of the Knox ranges from zero in Ottawa County to the north to more than 1400 feet in southern Ohio. Janssens (1973) attributes the northward thinning of the Knox largely to the following three factors:

1. Depositional thinning within the Knox.
2. Local relief on top of the Knox as a result of erosion prior to the Middle Ordovician.
3. The effect of regional truncation prior to the Middle Ordovician time which took place after the Sauk sequence rocks in Ohio had been gently folded into a southward-plunging anticline. Janssens feels that this factor probably accounted for more than half the rate of thinning shown.

Map 3, entitled "Structure Map On The Knox Dolomite", is a paleo-topographic map of the Knox unconformity as well as a regional structure map of the Knox. Because the top of the Knox is an unconformable surface, it is impossible to differentiate between paleo-topography and true structure in each local anomoly, but on a regional scale the structure of the area is shown. The attitude of this surface is for the most part a result of Middle through Late Paleozoic subsidence of the Michigan and Appalachian Basins. In eastern Ohio, subsidence of the Appalachian Basin has resulted in a regional dip which increases to east and southeast. This is an important characteristic to note because conversely this means the Knox unconformity rises to the west. Therefore, in southern Ohio where the Rose Run subcrop is found at its westernmost position (see Map 1), it would be most economically feasible for exploration because the unit can be reached at very shallow depths.

LOCAL CHARACTERISTICS OF THE KNOX AT THE KNOX UNCONFORMITY IN STUDY AREA

In order to make a more detailed study of the Rose Run subcrop, I have prepared three subsurface maps of the Knox (Maps 4, 5 and 6) which can be found in the pocket at the end of this report. These maps characterize the Knox at the Knox unconformity in the more restricted east central Ohio area, encompassing portions of Coshocton, Holmes, Wayne and Tuscarawas counties. This area was chosen for the more localized study because, as I have mentioned, it is the only place along the Rose Run subcrop that provides sufficient control for mapping of the Knox. In this area, approximately 60 wells have penetrated the Knox, many of which became commercially productive (see Appendix C). These wells provided the data necessary for the preparation of my maps.

The major purpose of Maps 4 and 5 is to define where the subcrop of the Rose Run most probably exists at the Knox unconformity. Map 5 is an isopach map of the Rose Run, while Map 4 is an isopach map of the overlying "Beekmantown" Dolomite. As I have previously stated, the zero edges obtained by both of these maps define the probable subcrop area of the Rose Run at the unconformity.

Map 6, which is a structure-topographic contour map on the Knox unconformity with the probable subcrop area of the Rose Run transferred onto it, is the most important map of this study. The structure-topographic contours, combined with the location of the Rose Run subcrop, provide very valuable information for oil and gas exploration. Of primary importance is the western or zero edge of the Rose Run where it pinches out updip and is closed against the regional structure. At this edge, the possibility of large scale stratigraphic entrapment of hydrocarbons is quite real. Also of much importance is the occurence of structural or topographic highs within the Rose Run subcrop shown by the map. Most of the production in the area has apparently been found from this type of trap. The structure penetrated by the #1 Reuben Erb (Permit No. 1328), drilled in section 23 of Clark Township in Holmes County, can even be mapped on the Berea Sandstone (Mississippian) according to Janssens (1973). Throughout the mapped area, many structural highs are shown which remain untouched by the drill. If the structural interpretations are correct, these areas would be prime prospects for exploration.

Of particular interest are the apparent outliers of "Beekmantown" Dolomite overlying the Rose Run subcrop.

There appears to be some sort of relationship between much of the production in the area and the occurence of these features. A few of these outliers are even productive from the "Beekmantown" (see Appendix C), indicating that in some cases the "Beekmantown" as well as the Rose Run may have the porosity necessary for oil and gas containment. These outliers generally trend northeast to southwest, which is the same as the regional trend of the Rose Run subcrop. If the interpretation on the map is correct, extensions of these trends could be expected to be productive.

RESULTS OF STUDY

The results of this study can be summed up best by the following:

1. The Rose Run Sandstone is a most viable reservoir for the entrapment of oil and gas in Ohio, and the possibility of subregional stratigraphic trapping exists at the updip pinch out edge of the Rose Run subcrop at the Knox unconformity.
2. The "Knox sand" as defined by Patten and Dawson, is possibly correlative to the Rose Run, and this sand may have the same potential on the western flank of the Cincinnati Arch that the Rose Run does on the eastern flank.
3. As shown in the study area, the use of isopach maps of the Rose Run, combined with regional structure contour maps, based on all available well control, is a viable prospecting approach to locating accumulations of oil and gas that may cover relatively large areas.
4. In the study area, there appears to be some sort of relationship between oil and gas production and the existence of "Beekmantown" erosional remnants, suggesting that extensions of the features may lead to further discoveries.

A most important point which I hope this study has illustrated is the definite potential for major discoveries here in this state. To extend this further, there no doubt exists many prospects with equal or greater promise nationwide. An article from The American Oil and Gas Reporter (pp. 69-72) based on the work of L. Frank Pitts, an independent oil and gas producer of the Pitts Energy Group from Dallas, states "A lot of domestic oil and gas remains to be found". The article further states that "we presently are drilling less than 50,000 wells a year. We should be drilling 80,000 wells a year minimum, many of which must be deeper wells." A map included with the article shows the prospective sediments in the United States favorable to oil and gas development. This map goes on to conclude that 98% of the prospective sediments in the United States remain untouched by drilling, mainly because of "politically motivated low prices". If the preceeding information is correct, it is impossible to understand how the United States, one of the world's wealthiest and most technologically advanced nations, can allow the current energy problems to continue, especially when major exploration prospects obviously exist in this country.

APPENDIX A

SUBSURFACE DATA USED IN PREPARATION OF STRUCTURE CONTOUR MAP FROM WELL INFORMATION CARDS AND BULLETIN 64 (A. JANSSENS, 1973)

County	Township	Permit No.	Depth To Knox Unconformity	Surface Elevation	Sub-sea Elevation Of Knox
Coshocton	Clark	96	5512* ft.	790T* ft.	-4722 ft.
	Crawford	1825	6550*	1201 KB*	-5349
	Crawford	1995	6235	938 KB	-5297
	Crawford	2177	6518	1191 KB	-5327
	Crawford	2667	6536	971.5 KB	-5564.5
	Crawford	2883	——	——	——
	Crawford	3081	6629	1125 KB	-5504
	Franklin	2599	6222	1000 T	-5222
	Jackson	2415	6108	1001 KB	-5107
	Jackson	2552	5954	752 KB	-5202
	Jackson	2595	6115	918 KB	-5197
	Jackson	2633	6072	917 KB	-5155
	Jackson	2671	——	——	——
	Keene	2131	——	——	——
	Keene	3092	6160	948 KB	-5212
	Lafayette	2955	——	——	——
	Oxford	2757	——	——	——
	Tuscarawas	2576	——	——	——
	Tuscarawas	2617	6427	1039 KB	-5388
	Tuscarawas	2686	——	——	——
	Tuscarawas	2733	6350	1038 KB	-5312
	Tuscarawas	2758	6338	1064 KB	-5274
	Tuscarawas	2765	6362	1046 KB	-5316

Tuscarawas	2775	6306	967 KB	-5369
Tuscarawas	2793	6336	1028 KB	-5308
Tuscarawas	2823	6061	763 KB	-5298
Tuscarawas	2917	6000	770 KB	-5230
Tuscarawas	2921	——	——	——
Tuscarawas	2951	6437	1046 KB	-5391
Tuscarawas	2966	——	——	——
Tuscarawas	3166	——	——	——
Tuscarawas	3178	6035	756 KB	-5279
Virginia	2144	5972	870 KB	-5102
Virginia	2183	5992	800 KB	-5192
Virginia	2268	5973	871 KB	-5102
Virginia	2460	6154	1000 KB	-5154
Virginia	2570	5934	859 KB	-5075
White Eyes	2145	6542	9596	-5583
White Eyes	2511	6498	1010 KB	-5488
White Eyes	2621	6484	987 KB	-5497
White Eyes	2653	6577	1128 KB	-5449
White Eyes	2688	——	——	——
White Eyes	2724	6439	1048 KB	-5391
White Eyes	2725	6185	855 KB	-5330
White Eyes	2735	6289	938 KB	-5351
White Eyes	2736	6165	829 KB	-5336
White Eyes	2768	6503	1045 KB	-5458
White Eyes	2828	——	——	——
White Eyes	2837	——	1020 KB	——
White Eyes	2838	——	——	——
White Eyes	2895	6558	1064 KB	-5494
White Eyes	2913	6426	844 T	-5582
White Eyes	2919	——	——	——
White Eyes	3091	6525	1047 KB	-5478
White Eyes	3138	6484	888 KB	-5596
White Eyes	3169	6564	1120 KB	-5444

	White Eyes	3213	6535	1080 KB	-5455
	White Eyes	3244	6442	1028 KB	-5414
	White Eyes	3276	6496	1006 KB	-5490
	White Eyes	3277	6359	830 KB	-5529
Holmes	Berlin	1279	6396	1088 KB	-5308
	Clark	1297	6538*	1123*KB	-5415
	Clark	1328	6416	1062 KB	-5354
	Clark	1352	6530*	1158*KB	-5372
	Clark	1391	6565	1160 KB	-5405
	Clark	1417	6526	1191 KB	-5335
	Clark	1609	6440	1045 KB	-5395
	Clark	2093	———	———	———
	Mechanic	1522	6092	991 KB	-5101
	Paint	1409	6423	1000 KB	-5423
	Salt Creek	1283	6412*	1316*KB	-5096
	Walnut Creek	1351	6636*	1211*KB	-5425
Tuscarawas	Bucks	2960	6760	1184	-5576
	Sugar Creek	1145	6661*	1000*KB	-5661
Wayne	Paint	1765	6400	1050 G	-5350

* Data obtained from Bulletin 64 (A. Janssens, 1973)

APPENDIX B

SUBSURFACE DATA USED IN PREPARATION OF ISOPACH MAPS
FROM WELL INFORMATION CARDS AND BULLETIN 64 (A. JANSSENS, 1973)

County	Township	Permit No.	Thickness Beekmantown	Thickness Rose Run
Coshocton	Clark	96	0 feet	0* feet
	Crawford	1825	—	—
	Crawford	1995	17	83
	Crawford	2177	0	67
	Crawford	2667	0	68
	Crawford	2883	—	—
	Crawford	3081	0	24+
	Franklin	2599	0	127
	Jackson	2415	21	5
	Jackson	2552	0	12+
	Jackson	2595	0	110
	Jackson	2633	44	31
	Jackson	2671	—	—
	Keene	2131	—	—
	Keene	3092	0	40
	Lafayette	2955	—	—
	Oxford	2757	—	—
	Tuscarawas	2576	—	—
	Tuscarawas	2617	0	106+
	Tuscarawas	2686	—	—
	Tuscarawas	2733	0	29+
	Tuscarawas	2758	0	32+
	Tuscarawas	2765	0	18+

Tuscarawas	2775	0	17+
Tuscarawas	2793	19	83+
Tuscarawas	2823	0	14+
Tuscarawas	2917	82	88
Tuscarawas	2921	—	—
Tuscarawas	2951	0	81+
Tuscarawas	2966	—	—
Tuscarawas	3166	—	—
Tuscarawas	3178	0	121+
Virginia	2144	0	78
Virginia	2183	0	64
Virginia	2268	0	38+
Virginia	2460	0	58
Virginia	2570	50	66
White Eyes	2145	0	41
White Eyes	2511	61	95
White Eyes	2621	0	166+
White Eyes	2653	45	38+
White Eyes	2688	—	—
White Eyes	2724	36	128+
White Eyes	2725	71	44+
White Eyes	2735	77	23+
White Eyes	2736	42	10+
White Eyes	2768	0	80
White Eyes	2828	—	—
White Eyes	2837	—	—
White Eyes	2838	—	—
White Eyes	2895	0	74+
White Eyes	2913	0	65+
White Eyes	2919	—	—
White Eyes	3091	44	105+
White Eyes	3138	0	128
White Eyes	3169	0	76+

	White Eyes	3213	0	85+
	White Eyes	3244	68	103+
	White Eyes	3276	0	Present
	White Eyes	3277	13	100+
Holmes	Berlin	1279	0	0
	Clark	1297	0	Present*
	Clark	1328	42	54+
	Clark	1352	8*	116+
	Clark	1391	20	96+
	Clark	1417	0	63
	Clark	1609	0	80
	Clark	2093	—	—
	Mechanic	1522	0	50
	Paint	1409	25	67
	Salt Creek	1283	0	0
	Walnut Creek	1351	0*	46
Tuscarawas	Bucks	2960	86	120+
	Sugar Creek	1145	0	Present*
Wayne	Paint	1765	27	54

* Data obtained from Bulletin 64 (A. Janssens, 1973)

APPENDIX C

PRODUCTION INFORMATION FROM WELL INFORMATION CARDS

County	Township	Permit No.	Rose Run Oil	Rose Run Gas	Beekmantown Oil	Beekmantown Gas
Coshocton	Clark	96	—	—	—	—
	Crawford	1825	—	—	—	—
	Crawford	1995	—	—	—	—
	Crawford	2177	—	—	—	—
	Crawford	2667	—	—	—	—
	Crawford	2883	—	—	—	—
	Crawford	3081	—	316 MCFG	—	—
	Franklin	2599	—	S/G	—	—
	Jackson	2415	—	—	—	—
	Jackson	2552	10 BOPD	350 MCFG	—	—
	Jackson	2595	—	25 MCFG	—	—
	Jackson	2633	—	—	—	—
	Jackson	2671	—	—	—	—
	Keene	2131	—	—	—	—
	Keene	3092	—	—	—	—
	Lafayette	2955	—	—	—	—
	Oxford	2757	—	—	—	—
	Tuscarawas	2576	—	—	—	—
	Tuscarawas	2617	—	—	—	—
	Tuscarawas	2686	—	—	—	—
	Tuscarawas	2733	—	200 MCFG	—	—
	Tuscarawas	2758	—	10 MCFG	—	—
	Tuscarawas	2765	—	—	—	—

Tuscarawas	2775	—	250 MCFG	—	—
Tuscarawas	2793	—	—	—	70 MCFG
Tuscarawas	2823	—	—	—	—
Tuscarawas	2917	10 BO	150 MCFG	—	—
Tuscarawas	2921	—	—	—	—
Tuscarawas	2951	—	—	—	—
Tuscarawas	2966	—	—	—	—
Tuscarawas	3166	—	—	—	—
Tuscarawas	3178	—	—	—	—
Virginia	2144	10 BOPD	S/G	—	—
Virginia	2183	—	—	—	—
Virginia	2268	S/O	S/G	—	—
Virginia	2460	—	—	—	—
Virginia	2570	—	—	—	—
White Eyes	2145	—	—	—	—
White Eyes	2511	Tr/O	635 MCFG	—	—
White Eyes	2621	—	S/G	—	—
White Eyes	2653	4 BO	350 MCFG	—	—
White Eyes	2688	—	—	—	—
White Eyes	2724	—	250 MCFG	—	—
White Eyes	2725	—	—	17 BO	700 MCFG
White Eyes	2735	—	—	15 BO	200 MCFG
White Eyes	2736	3 BO	400 MCFG	—	—
White Eyes	2768	—	150 MCFG	—	—
White Eyes	2828	—	—	—	—
White Eyes	2837	—	500 MCFG	—	—
White Eyes	2838	—	—	—	—
White Eyes	2895	2 ½ BO	300 MCFG	—	—
White Eyes	2913	—	—	—	—
White Eyes	2919	—	—	—	—
White Eyes	3091	25 BO	40 MCFG	—	—
White Eyes	3138	4 BO	150 MCFG	—	—
White Eyes	3169	1 BO	200 MCFG	—	—

	White Eyes	3213	—	20 MCFG	—	—
	White Eyes	3244	—	—	—	350 MCFG
	White Eyes	3276	—	60 MCFG	—	—
	White Eyes	3277	—	—	—	—
Holmes	Berlin	1279	—	—	—	—
	Clark	1297	—	—	—	—
	Clark	1328	10 BO	2,1 MMCFG	—	—
	Clark	1352	—	—	—	—
	Clark	1391	—	—	—	—
	Clark	1417	—	—	—	—
	Clark	1609	—	—	—	—
	Clark	2093	—	—	—	—
	Mechanic	1522	—	—	—	—
	Paint	1409	—	—	—	—
	Salt Creek	1283	—	—	—	—
	Walnut Creek	1351	—	—	—	—
Tuscarawas	Bucks	2960	—	—	—	—
	Sugar Creek	1145	—	—	—	—
Wayne	Paint	1765	—	—	—	—

APPENDIX D

SAMPLE DESCRIPTIONS

Coshocton County
Virginia Township

Cyclops Corp.
Three Springs Farm, Inc. #2
Permit No. 2570
Sample No. 3379

Depth (ft)	
5750-5760	Limestone 90%, buff to white, finely crystalline to coarsely crystalline granular in part. Shale 10%, dark green-gray, calcareous, pyritic
5760-5770	Limestone 50% as above. Shale 50% as above (cavings?)
5770-5780	As above
5780-5790	Limestone 80% as above. Shale 20% as above (cavings?)
5790-5800	Limestone 100% as above. With a trace of shale as above (cavings?)
5800-5810	Limestone 50% as above, chalky white in part. Shale 50% as above (cavings?)
5810-5820	Limestone 100% as above, light brown in part. Trace of shale as above (cavings?)
5820-5830	Very poor sample (cavings?)
5830-5840	Limestone 100% as above
5840-5850	As above
5850-5860	As above
5860-5870	As above
5870-5880	As above
5880-5890	Limestone 80% as above. Shale 20% as above (cavings?)
5890-5900	Limestone 50% as above. Shale 50% as above (cavings?)
5900-5910	Sample missing
5910-5920	Limestone 80% as above. Shale 20% as above (cavings?)
5920-5930	Limestone 80% as above. Shale 20% as above (cavings?). Trace of dark gray-green dolomite, finely crystalline (Glenwood?)
5930-5940	Limestone 80%, light brown, finely crystalline. Dolomite 10% (Beekmantown?) dark brown, medium to coarsely crystalline granular, oil stained in part. Dolomite 10%, gray-green, argillacous (Glenwood?). Trace of shale as above

5940-5950	As above, dolomite oil stained in part
5950-5960	Dolomite 60%, white to light gray, finely crystalline to medium crystalline granular, with a trace of oil stain as above. Dolomite 30%, medium to dark gray-green, argillaceous (Glenwood?). Shale 10% as above (cavings?)
5960-5965	As above
5965-5970	As above
5970-5975	As above
5975-5980	As above
	End of sample range 5980
	Rose Run samples missing

Coshocton County
White Eyes Township

Columbia Gas Transm. Corp.
Opportunity Ranch Inc. #1
Permit No. 2145
Sample No. 2921

Depth (ft)	
6330-6340	Limestone 95%, medium to light brown, very finely crystalline. Shale 5%, black
6350-6360	Limestone 95% as above, slightly argillaceous in part. Shale 5%, black as above
6360-6370	Limestone 10%, light gray to brown, very finely crystalline. Trace of black shale as above
6370-6380	Limestone 95% as above. Shale 5% as above
6380-6390	As above
6390-6400	Limestone 95%, medium to dark gray, brown in part, also argillaceous in part. Shale 5% as above
6400-6410	Somewhat less argillaceous, otherwise as above
6410-6420	As above
6420-6430	Limestone 90% as above, light brown or rusty in part. Shale 10% as above
6430-6440	As above
6440-6450	As above
6450-6460	As above

6460-6470	Limestone 80%, white and microcrystalline. Shale 20%, light gray with a trace of green dolomite in part
6470-6480	Limestone 80%, medium gray, very finely crystalline. Dolomite 20%, gray to green, very finely crystalline and argillaceous (Glenwood)
6480-6490	Limestone 70% as above. Dolomite 30% as above (Glenwood)
6490-6500	Limestone 50% as above. Glenwood dolomite gray to green, 50% as above
6500-6510	Glenwood somewhat more argillaceous, otherwise as above
6510-6520	Shale 100%, medium gray to green, very dolomitic
6520-6530	Dolomite 100%, very argillaceous (Glenwood). Trace of several sand grains, medium to coarse grained, loose subrounded grains
6530-6540	Sand 100%, medium to coarse grained, subrounded to rounded, all loose grains, excellent porosity, excellent reservoir (Rose Run)
6540-6550	Sandstone 100% as above
6550-6560	As above
6560-6570	As above
6570-6580	As above
6580-6590	As above
6590-6590	Dolomite 100%, light gray, finely to very finely crystalline, may be very slightly porous in part (Copper Ridge?)
6590-6600	As above
6600-6610	Dolomite 100%, white to light gray, medium crystalline, crystallinity granular and slightly porous in part; with a trace of pinpoint vugs, several crystals with coarse sand grains in light dolomite matrix
6610-6620	Dolomite 100%, very finely crystalline, otherwise as above
6620-6630	As above
6630-6640	As above, with a trace of pyrite

Holmes County
Clark Township

Pennzoil United, Inc.
Simon L. Miller #1
Permit No. 1417
Sample No. 2502

Depth (ft)	
6450-6460	Limestone 100%, medium to dark gray-brown, very finely crystalline
6460-6470	As above
6470-6480	As above
6480-6490	As above, with a trace of pyrite
6490-6500	Lime dust (poor sample)
6500-6510	Dolomite 50%, light green to dark gray-green, argillaceous with a trace of pyrite inclusions. Limestone 50% as above
6510-6520	Dolomite 80%, light green as above (Glenwood?). Sand 20%, loose quartz grains, coarse grained, subrounded to well rounded (Rose Run?)
6520-6530	Sand 100%, medium to coarse loose sand grains, subrounded to well rounded, excellent porosity (Rose Run)
6530-6540	As above
6540-6550	As above
6550-6560	Poor sample (cavings?)
6560-6570	Dolomite 100%, white, finely crystalline, nonporous
6570-6580	Dolomite 100%, white to light brown, medium crystalline; trace of pinpoint porosity
6580-6590	As above, coarsely crystalline in part
6590-6600	As above with pyrite inclusions in part
6600-6610	As above
6610-6620	As above
6620-6630	As above
6630-6640	As above
6640-6650	Dolomite 80% as above, medium brown in part with abundant vuggy pinpoint porosity. Sandstone 20%, white, coarse well rounded quartz grains in a dolomitic cement; nonporous

Holmes County
Mechanic Township

Allegh. Ld. & Min. Co.
Noah L. Raber #1
Permit No. 1522
Sample No. 2779

Depth (ft)	
5900-5910	Limestone 100%, light brown, very finely to finely crystalline
5910-5920	As above, medium gray in part
5920-5930	As above, medium crystalline granular in part
5930-5940	As above
5940-5950	As above
5950-5960	As above
5960-5970	Limestone 100%, medium gray to brown, finely crystalline
5970-5980	As above
5980-5990	Limestone 100%, light brown, buff and white, finely crystalline
5990-6000	As above, dark gray in part
6000-6010	As above
6010-6020	As above
6020-6030	Limestone 100%, white and buff, micro crystalline
6030-6040	Limestone 100% as above, with a trace of dolomite, medium green, argillaceous
6040-6050	Limestone 100%, medium to dark brown, finely crystalline. Trace of dolomite, light green, argillaceous (Glenwood?)
6050-6055	Shale 80%, medium to dark gray-green, dolomitic (Glenwood?). Limestone 20% as above
6055-6060	Shale 50% as above. Limestone 50%, white to light gray, finely crystalline
6060-6065	Dolomite 100%, light to medium green (Glenwood), finely crystalline, argillaceous in part. Trace of several coarse well rounded, loose sand grains
6065-6070	Increased loose sand grains, otherwise as above

6070-6075	Dolomite 50% as above, white and very finely crystalline in part. Sandstone 50%, very fine grained to coarse grained, poorly sorted, subangular to subrounded (Rose Run?)
6075-6080	Dolomite 95%, light green-gray, argillaceous as above. Sandstone 5%, coarse, loose, well rounded grains as above (Rose Run?)
6080-6085	Dolomite 50%, light green-gray as above. Sand grains 50%, medium to coarse grained as above, dominantly subrounded, well rounded in part (Rose Run?)
6085-6090	Loose sand grains 100%, coarse, subrounded to well rounded, excellent porosity and permeability (Rose Run)
6090-6095	As above
6095-6100	As above
6100-6105	As above, with a white dolomitic cement or matrix in part
6105-6110	Sandstone 100%, white, medium to coarse grained, dominantly nonporous, dolomitic cement or matrix
6110-6115	Dolomite 70%, white, finely crystalline. Sandstone 30% as above
6115-6120	As above
6120-6125	As above
6125-6130	Poor sample (cavings?)
6130-6135	Dolomite and sandstone as above
6135-6140	As above
6140-6145	Poor sample (cavings?)
6145-6150	Poor sample (cavings?)
6150-6155	Poor sample (cavings?)
6155-6160	Dolomite 100%, white, very finely to finely crystalline, finely crystalline granular in part, abundant cavings in sample

6160-6165	As above, gray-brown in part
6165-6170	Dolomite 100%, light brown to white, medium crystalline granular and porous, many loose crystals in sample
6170-6175	Dolomite 100%, medium to light gray-brown, fine to medium crystalline, crystalline granular in part, dominantly nonporous
6175-6176	As above
TD	

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